MARKED-UP CLAIMS WITH AMENDMENTS SHOWN

(1). A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have a dynamic hardness value from 26 to 30, which is obtained by the following formula:

$DH=KxPmax/hmax^2$,

wherein DH is dynamic hardness, K is a constant value <u>assigned to the</u> [based on an] indentator [inherent to] <u>used to test</u> the liquid crystal display, Pmax is maximum load, and hmax is the total maximum variation obtained by adding <u>the measured</u> elastic deformation and plastic deformation <u>under load</u>.

(2). A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have a hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$HV=KxPmax/hr^2$,

wherein HV is hardness of plastic deformation, K is a constant value assigned to the [based on an] indentator used to test [inherent to] the liquid crystal display, Pmax is maximum load, and hr is measured variation when the tangent in the maximum variation point of a curb has no load in the case of unloading.

(3). A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have dynamic hardness value (DH) from 26 to 30, which is obtained by the following formula:

$DH=KxPmax/hmax^2$,

wherein DH is dynamic hardness, K is a constant value assigned to the [based on an] indentator [inherent to] used to test the liquid crystal display, Pmax is maximum load, and hmax is the total maximum variation obtained by adding the measured elastic deformation and plastic deformation under load,

and wherein said spacers have a hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$HV=KxPmax/hr^2$,

wherein HV is hardness of plastic deformation, K is a constant value assigned to the [based on an] indentator used to test [inherent to] the liquid crystal display, Pmax is maximum load, and hr is measured variation when the tangent in the maximum variation point of a curb has no load in the case of unloading.

(13) The liquid crystals according to claim 1 wherein for rectangular spacers, the length of one side of the upper spacer surface is 50 to 90% smaller than the length of [said spacers

have the ratio of one side of the upper to] one side of the lower spacer surface [bottom for a rectangle or] and wherein for circular spacers, [the ratio of] the diameter of the upper spacer surface is [bottom to the diameter of the lower bottom for circular shape of from] 50 to 90% smaller than the diameter of the lower spacer surface.

(14) The liquid crystals according to claim 2 wherein for rectangular spacers, the length of one side of the upper spacer surface is 50 to 90% smaller than the length of [said spacers have the ratio of one side of the upper to] one side of the lower spacer surface [bottom for a rectangle or] and wherein for circular spacers, [the ratio of] the diameter of the upper spacer surface is [bottom to the diameter of the lower bottom for circular shape of from] 50 to 90% smaller than the diameter of the lower spacer surface.

(15) The liquid crystals according to claim 3 wherein for rectangular spacers, the length of one side of the upper spacer surface is 50 to 90% smaller than the length of [said spacers have the ratio of one side of the upper to] one side of the lower spacer surface [bottom for a rectangle or] and wherein for circular spacers, [the ratio of] the diameter of the upper spacer surface is [bottom to the diameter of the lower bottom for

circular shape of from] 50 to 90% smaller than the diameter of the lower spacer surface.

(16) The liquid crystals according to claim 4 wherein for rectangular spacers, the length of one side of the upper spacer surface is 50 to 90% smaller than the length of [said spacers have the ratio of one side of the upper to] one side of the lower spacer surface [bottom for a rectangle or] and wherein for circular spacers, [the ratio of] the diameter of the upper spacer surface is [bottom to the diameter of the lower bottom for circular shape of from] 50 to 90% smaller than the diameter of the lower spacer surface.

(17) The liquid crystals according to claim 5 wherein for rectangular spacers, the length of one side of the upper spacer surface is 50 to 90% smaller than the length of [said spacers have the ratio of one side of the upper to] one side of the lower spacer surface [bottom for a rectangle or] and wherein for circular spacers, [the ratio of] the diameter of the upper spacer surface is [bottom to the diameter of the lower bottom for circular shape of from] 50 to 90% smaller than the diameter of the lower spacer surface.

(18) The liquid crystals according to claim 6 wherein for rectangular spacers, the length of one side of the upper spacer

surface is 50 to 90% smaller than the length of [said spacers have the ratio of one side of the upper to] one side of the lower spacer surface [bottom for a rectangle or] and wherein for circular spacers, [the ratio of] the diameter of the upper spacer surface is [bottom to the diameter of the lower bottom for circular shape of from] 50 to 90% smaller than the diameter of the lower spacer surface.

(19) The liquid crystals according to claim 7 wherein for rectangular spacers, the length of one side of the upper spacer surface is 50 to 90% smaller than the length of [said spacers have the ratio of one side of the upper to] one side of the lower spacer surface [bottom for a rectangle or] and wherein for circular spacers, [the ratio of] the diameter of the upper spacer surface is [bottom to the diameter of the lower bottom for circular shape of from] 50 to 90% smaller than the diameter of the lower spacer surface.

(20) The liquid crystals according to claim 12 wherein said spacers have the length of one side of the upper bottom equal to the length of one side of the lower bottom decreased by from 0.5H to 0.9H, where H is [certain ratio from] the maximum height of said spacers, or the diameter of the upper bottom equal to [that] the diameter of the lower bottom decreased by [said ratio from] from 0.5H to 0.9H, where H is the maximum height of said spacers.

(21) The liquid crystals according to claim 13 wherein said spacers have the length of one side of the upper bottom equal to the length of one side of the lower bottom decreased by from 0.5H to 0.9H, where H is [certain ratio from] the maximum height of said spacers, or the diameter of the upper bottom equal to [that] the diameter of the lower bottom decreased by [said ratio from] from 0.5H to 0.9H, where H is the maximum height of said spacers.

(22) The liquid crystals according to claim 14 wherein said spacers have the length of one side of the upper bottom equal to the length of one side of the lower bottom decreased by from 0.5H to 0.9H, where H is [certain ratio from] the maximum height of said spacers, or the diameter of the upper bottom equal to [that] the diameter of the lower bottom decreased by [said ratio from] from 0.5H to 0.9H, where H is the maximum height of said spacers.

(23) The liquid crystals according to claim 15 wherein said spacers have the length of one side of the upper bottom equal to the length of one side of the lower bottom decreased by from 0.5H to 0.9H, where H is [certain ratio from] the maximum height of said spacers, or the diameter of the upper bottom equal to [that] the diameter of the lower bottom decreased by [said ratio from] from 0.5H to 0.9H, where H is the maximum height of said spacers.

(24) The liquid crystals according to claim 16 wherein said spacers have the length of one side of the upper bottom equal to <u>the length of</u> one side of the lower bottom decreased by <u>from 0.5H to 0.9H, where H is</u> [certain ratio from] the maximum height of said spacers, or the diameter of the upper bottom equal to [that] <u>the diameter</u> of the lower bottom decreased by [said ratio from] <u>from 0.5H to 0.9H, where H is</u> the maximum height of said spacers.

(25) The liquid crystals according to claim 17 wherein said spacers have the length of one side of the upper bottom equal to <u>the length of</u> one side of the lower bottom decreased by <u>from 0.5H to 0.9H, where H is</u> [certain ratio from] the maximum height of said spacers, or the diameter of the upper bottom equal to [that] <u>the diameter</u> of the lower bottom decreased by [said ratio from] <u>from 0.5H to 0.9H, where H is</u> the maximum height of said spacers.

(26) The liquid crystals according to claim 18 wherein said spacers have the length of one side of the upper bottom equal to <u>the length of</u> one side of the lower bottom decreased by <u>from 0.5H to 0.9H, where H is</u> [certain ratio from] the maximum height of said spacers, or the diameter of the upper bottom equal to [that] <u>the diameter</u> of the lower bottom decreased by [said ratio from] <u>from 0.5H to 0.9H, where H is</u> the maximum height of said spacers.

(27) The liquid crystals according to claim 19 wherein said spacers have the length of one side of the upper bottom equal to the length of one side of the lower bottom decreased by from 0.5H to 0.9H, where H is [certain ratio from] the maximum height of said spacers, or the diameter of the upper bottom equal to [that] the diameter of the lower bottom decreased by [said ratio from] from 0.5H to 0.9H, where H is the maximum height of said spacers.

(29). The method according to claim 28 wherein said selecting of a photosensitive resin comprises choosing a photosensitive resin based on at least one of the group consisting of:

(a) a dynamic hardness value from 26 to 30, which is obtained by the following formula:

$DH=KxPmax/hmax^2$,

wherein DH is dynamic hardness, K is a constant value assigned to the [based on an] indentator used to test [inherent to] the liquid crystal display, Pmax is maximum load, and hmax is the total maximum variation obtained by adding the measured elastic deformation and plastic deformation under load;

(b) a hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$HV=KxPmax/hr^2$,

wherein HV is hardness of plastic deformation, K is a constant value assigned to the [based on an] indentator used to

test [inherent to] the liquid crystal display, Pmax is maximum load, and hr is measured variation when the tangent in the maximum variation point of a curb has no load in the case of unloading;

(c) [dynamic hardness value from 26 to 30, which is obtained by the following formula:

$$DH=KxPmax/hmax^2,$$

wherein DH is dynamic hardness, K is a constant value based on an indentator used to test [inherent to] the liquid crystal display, Pmax is maximum load, and hmax is the total maximum variation obtained by adding elastic deformation and plastic deformation and wherein said spacers have a hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$$HV=KxPmax/hr^2,$$

wherein HV is hardness of plastic deformation, K is said constant, Pmax is maximum load, and hr is variation when the tangent in the maximum variation point of a curb has no load in the case of unloading;

(d)] an elastic coefficient from 100 to 500 kg/mm^2; a linear expansion coefficient which is nearly equal to the coefficient of volume expansion per unit area of the liquid crystal;

[(e)] (d) wherein for rectangular spacers, the length of one side of the upper spacer surface is 50 to 90% smaller than the length of [the ratio of one side of the upper bottom to] one side

of the lower <u>spacer surface</u> [bottom for a rectangle or] <u>and wherein for circular spacers,</u> [the ratio of] the diameter of the upper <u>spacer surface is</u> [bottom to the diameter of the lower bottom for circular shape of from] 50 to 90% <u>smaller than the diameter of the lower spacer surface</u>; and

[(f)] <u>(e)</u> a column occupancy ratio from 0.05 to 0.86%, which is expressed as follows:

Column occupancy ratio=(Lower bottom area of column×column density/pixel area)×100

Column density: Total number of columns/total number of pixels.

REMARKS

Claims 1-29 are currently pending. The Examiner has again rejected Claims 1-3, 13-27 and 29 under 35 USC §112 as indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention; and, Claims 1-29 under 35 USC §103 as unpatentable over the combined teachings of Shioda and Kajita, et al. For the reasons set forth below, Applicants respectfully submit that Claims 1-29 are definite and patentable over the cited prior art.

In response to the rejection of claims under 35 USC §112, Applicants have again submitted amendments to the language of the rejected claims. Specifically, the Applicants have amended Claims 1-3 and 29 to include a more specific recitation of the constant K as a constant value assigned to the indentator which is used to test the liquid crystal display (see: Specification page 7, lines 8-9). The constant K is a value which is well-understood by those having skill in the relevant art. When liquid crystal displays are tested for dynamic hardness, each piece of test equipment (i.e., the indentator) has its calibration constant K. The reason that a single value is not recited is that different indentators (or indenters as referred to by Shioda) have different K values. For example, the cited Shioda patent describes (at Col. 14, lines 32, et seq) the

measurement of dynamic hardness using an indenter attachment (see, Col. 14, line 34) which would have its own value of K for external calibration. Shioda uses a K value of 3.8584 on line 38. Similarly, the cited Kajita patent details measuring the integrity of liquid crystal displays using microcompression testers (see: Col. 21, line 43, et seq) having K constant values built into the test conditions and calibrations. Clearly the terms which are used in the pending claims are terms of the art which would have distinct and definite meaning to one having skill in the art. Based on the amendments and the teachings of the references, Applicants respectfully request withdrawal of the 112 rejections of Claims 1-3 and 29.

With regard to the Examiner's rejection based on the use of the term "ratio of the diameter of the upper bottom to that of the diameter" in Claims 13-19 and 29, Applicants respectfully point out that the language of the claims has been amended to clarify the dimensional relationship. Applicants believe that the amended language is definite; and, Applicants request withdrawal of the rejections of Claims 13-19 and 29 under 35 USC 112.

Finally, in response to the rejection of the language of Claims 20-27 and 29 under 35 USC 112, Applicants first note that the Examiner's rejection is based on the original claim language and not the language as amended by the Amendment filed on May 16, 2002. Applicants have, nonetheless, again amended the language

of those claims to recite the structural limitations as detailed from the bottom of page 10 through page 11 of the Specification and in Figure 2B. Again, Applicants believe that the amendment language addressed the Examiner's concerns and removes any basis for rejection under 35 USC 112.

Claims 1-29 have been rejected under 35 USC §103 as unpatentable over the combined teachings of the Shioda and Kajita patents. Applicants first note that the Examiner has based the rejections on the prior claim language, stating that the vagueness of the K value (for Claims 1-3, and 29) as arbitrarily selected would be inherently met by any reference. Applicants respectfully request reconsideration of the rejections, in light of the express teachings from the Specification and the amendments to the claims. Clearly the claims recite a specific structure wherein the spacers have physical characteristics which are neither taught nor suggested by the cited patents. With regard to the Examiner's comment that Shioda discloses that the degree of plastic deformation is related to and described by DH, Applicants assert that Shioda simply notes that there is an inverse relationship between the two characteristics, which is understood from the general definitions of the two terms of the art. However, Shioda does not teach or suggest specific values for DH and HV. As such, Applicants respectfully conclude that the Shioda patent does not provide teachings which obviate the pending claim language.

With respect to Claims 12-27, Applicants again note that the language of the claims has been amended. Further, Applicants argue that even if the Examiner's statement, that it is "well known in the art that the sizes, position and number of spacers are determined in accordance with the rigidity of the liquid crystal panel", such would not obviate the substantially more specific claim language of specific relationships between the dimensions of the upper and lower spacer surfaces. Absent some citation of a reference which teaches or suggests those ratios/relationships, it cannot simply be concluded that the specific relationship language is obvious. Applicants respectfully remind that Examiner that obviousness can only be established by combining or modifying teachings of the prior art to produce the claimed invention when there is some teachings, suggestion or motivation to do so found either in the references themselves or in the knowledge generally available to one or ordinary skill in the art (*In re Fine,* 837 F. 2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). Since neither the Shioda nor the Kajita patent teaches or suggests the inventive spacer structures as claimed, and no other teaching, suggestion, or motivation has been provided, it cannot be maintained that the claim language is obvious. Shioda's teachings, from Col. 13, Col. 15 and Col. 23, regarding avoiding dynamic instability do not provide sufficient detail to obviate the claimed recitation of explicit DH and HV ranges, explicit dimensional relationships, and explicit column

would lead one skilled in the art to modify a ratio range with a specific formula for arriving at an actual ratio of certain-size columns in a defined pixel area, it cannot be maintained that Shioda obviates the claim language.

In response to the Examiner's comments regarding Claims 28 and 29, Applicants again note that the claims recite explicit values, relationships, and ranges which are simply not taught or suggested by the cited prior art. Accordingly, reconsideration of the rejections is respectfully requested.

Based on the foregoing amendments and remarks, Applicants request entry of the amendments, withdrawal of the rejections, and issuance of the claims.

Respectfully submitted,
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